Section 4

Statewide Rockfall Related Accident History

WSDOT's collision database shows that for the period from January 1, 1970 through September 30, 2005 there have been 19 reported fatal motor vehicle collisions on Washington State Highways, resulting in 21 deaths, caused by falling or fallen rocks or trees. Of these, the following 8 fatal collisions with a total of 10 fatalities were determined most likely to have involved falling or fallen rocks:

Reported Fatal State Highway Collisions Involving Falling or Fallen Rocks

Date	SR#	Milepost	Light	# Fatalities
7/25/1970	90	60.80	Daylight	1
8/8/1970	12	156.46	Dark	1
1/14/1973	14	55.22	Dark	1
6/24/1976	2	62.70	Daylight	1
9/21/1978	260	20.27	Dark	1
12/4/1978	395	1.00	Dark	1
2/5/1998	90	57.56	Dark	1
9/11/2005	90	50.30	Dark	3
Total				**10**

Source: WSDOT, Transportation Data Office, Collision Data and Analysis Branch

To place these totals in context, from January 1, 1970 through September 30, 2005:

- 26,993 traffic fatalities occurred on all roadways in Washington State;
- 13,722 traffic fatalities occurred on Washington State Highways;
- 21 persons were killed on Washington State Highways in vehicle collisions with wildlife.

Many incidents caused by rock falls and other geological roadway hazards do not result in fatalities; but nonetheless can still cause significant injuries or property damage. In order to see trends in these types of collisions, a detailed analysis was done of all reported state highway collisions involving falling or fallen rocks and trees for the period from January 1, 1999 through September 30, 2005. This time frame was chosen because 1999 is the earliest year for which copies of collision reports are still available. By reviewing each collision report, it can be ascertained if the collision involved a falling rock or a falling tree (normally these two items are combined in the database). As a result of this review, it was determined there was a total of 212 reported collisions involving falling/fallen rocks and another 176 collisions involving falling or fallen trees during this time period.

As the table below indicates, the majority of reported collisions involving falling or fallen rocks are property damage only (PDO). With the exception of 2002, the number of such collisions has remained somewhat stable from year to year, except for a spike in 2002 of property damage only collisions. The "spike" in the 2002 collisions was due strictly to an increase in PDO collisions; the injury and fatal collision totals for this year were at or near their respective six-year average.

Reported State Highway Collisions Involving Falling or Fallen Rocks

	1999	2000	2001	2002	2003	2004	Jan-Sep 2005	Total	1999-2004 Average
PDO Collisions	19	21	16	46	29	26	8	165	26.2
Injury Collisions	5	8	8	9	7	8	1	46	7.5
Fatal Collisions	0	0	0	0	0	0	1	1	0.0
Total Collisions	24	29	24	55	36	34	10	212	33.7

Source: WSDOT, Transportation Data Office, Collision Data and Analysis Branch

The month(s) in which the rock collisions occurred most often were as follows:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
1999											4	
2000					4							4
2001											7	
2002												17
2003	10											
2004	9											

The yearly totals for reported collisions involving falling or fallen trees tend to show more variance year-to-year than do the rock collisions. This may be due to wind and other weather conditions having more of an impact on the stability of trees. While not occurring as frequently as the rock collisions, the tree collisions tend to result in a higher percentage of injuries or fatalities when compared with the rock collisions.

Reported State Highway Collisions Involving Falling or Fallen Trees

	1999	2000	2001	2002	2003	2004	Jan-Sep 2005	Total	1999-2004 Average
PDO Collisions	18	8	16	21	26	27	8	124	19.3
Injury Collisions	13	5	7	2	15	7	1	50	8.2
Fatal Collisions	0	1	1	0	0	0	0	2	0.3
Total Collisions	31	14	24	23	41	34	9	176	27.8

Source: WSDOT, Transportation Data Office, Collision Data and Analysis Branch

The month(s) in which the tree collisions occurred most commonly are as follows:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
1999		11										
2000	6											
2001												8
2002												8
2003										10		
2004											6	

As can be seen below, on average the percentage of falling/fallen rock collisions resulting in injuries or fatalities is approximately one-half that of all state highway collisions, while falling/fallen tree collisions are 20% lower in severity.

Comparison of Collision Severity for Reported State Highway Collisions

	1999	2000	2001	2002	2003	2004	Jan-Sep 2005	Total
% Injury & Fatal – Falling/Fallen Rock Collisions	21%	28%	33%	16%	19%	24%	20%	22%
% Injury & Fatal – Falling/Fallen Tree Collisions	42%	43%	33%	9%	37%	21%	11%	30%
% Injury & Fatal - All Collisions	42%	43%	42%	40%	39%	38%	38%	40%

Source: WSDOT, Transportation Data Office, Collision Data and Analysis Branch

In summary, reported collisions involving falling or fallen rocks or trees are extremely rare occurrences, accounting for only 0.1% of all state highway collisions. Nonetheless, WSDOT remains committed to the proactive management of unstable slopes on our state highways.

Section 5

Major Highway Closure Due to Slope Failures (1985 to 2005)

Since 1985 WSDOT's highway system has experienced 21 slope failures that resulted in roadway closures in excess of a week. Fourteen were the result of landslides, four were rockslides, and three were debris flows. The majority of the slopes failed during or shortly after major storm event, while one slope failed as a result of the Nisqually Earthquake.

The longest highway closure occurred in 1990 when a hillside, approximately 24 acres in size, failed and completely destroyed over 700 feet of State Route 4. The estimated volume of this landslide was between 1.5 and 2.0 million cubic yards. Due to the complex nature of the landslide traffic was diverted onto six miles of paved one way (with turnouts) logging roads for over a year, before the landslide was stabilized and the highway re-established.

The winter of 1998/1999 was an especially bad year. For over six months western Washington experienced record-breaking rainfall from October 1998 to March 1999. Beginning in February 1999 large-scale landsliding began to occur in much of the region.

Five major two lane highway facilities, and one four lane highway facility had the west bound lanes were closed for extended periods of time, beginning in February 1999.

- Along SR 3, north of Allyn, a large landslide destroyed over 500 feet of highway, and continued to move for several months. The highway was not opened until a permanent tieback wall was constructed to stabilize the landslide.
- Along SR 18, east of Auburn, a landslide forced the closure of the westbound lanes. Emergency countermeasures required the construction of a counterweight berm in the westbound lanes to stop the landslide until a permanent cylinder pile wall could be constructed. Westbound traffic was routed onto the eastbound lanes.
- A large debris flow closed SR 20 east of Concrete.
- Two large landslides, north of Lilliwaup, occurred along US 101 at MP 322 and 326 and required long term closures until the landslide stopped moving. Long section of highway, in excess of 1000 feet, were buried by tens of thousands cubic yards of landslide debris which had to be removed once the landslides stopped moving.
- Just west of Port Orchard, along SR 166, a large landslide above the highway and buried the facility for over 3 months.

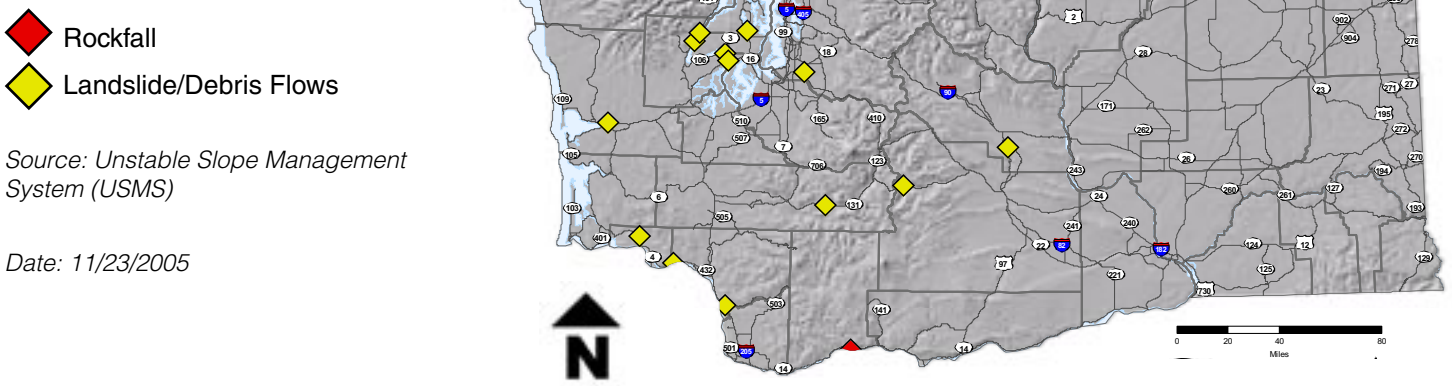
Table 5.1 provides information on these closures, and Figure 5.2 provides the location.

Table 5.1 Major roadway closure due to slope failures

State Route	Milepost	Location	Problem	Year	Duration
14	51.5	East of Stevenson	Rockslide closed all lanes	1986	1 week
101	184.0	South of Forks	Landslide closed all lanes	1986	1 week
20	124.0	West of Diablo	Rockslide closed all lanes	1989	1 month
112	32.0	East of Clallam Bay	Landslide closed all lanes	1990	6 months
4	24.5	West of Skamokawa	Landslide closed all lanes	1990	1 year
112	36.0	West of Joyce	Landslide closed all lanes	1990	6 months
12	114	West of Randle	Landslide closed all lanes	1994	3 weeks
20 Spur	49.0	South of Anacortes	Rockslide closed all lanes	1994	1 month
4	46.0	West of Stella	Debris flow closed all lanes	1996	1 week
5	24.0	North of Woodland	Landslide closed all NB lanes	1996	2 weeks
12	1.0	East of Aberdeen	Landslide closed all lanes	1996	1 week
821	20.0	South of Ellensburg	Debris flows closed all lanes	1998	2 weeks
101	322.0	North of Lilliwaup	Landslide closed all lanes	1999	3 months
101	326.0	North of Lilliwaup	Landslide closed all lanes	1999	3 months
3	22.5	North of Allyn	Landslide closed all lanes	1999	6 months
166	1.5	West of Port Orchard	Landslide closed all lanes	1999	3 months
18	7.0	East of Auburn	Landslide closed WB lanes	1999	6 months
20	90.0	West of Concrete	Debris flow closed all lanes	1999	1 week
302	4.5	West of Victor	Landslide closed all lanes	2001	2 months
20	121.0	East of Newhalem	Rockslide closed all lanes	2003	2 months
12	154.5	East of White Pass	Landslide closed EB lanes	2003	2 weeks
20	150.0	East of Diablo	Debris flows closed all lanes	2004	1 week

Figure 5.2

Highway Closures Due to Slope Failures along State Routes in Washington State



Source: Unstable Slope Management System (USMS)

Date: 11/23/2005

Section 6

Avalanche Hazards Along Snoqualmie Pass

Snow Slide Collision History Discussion for Unstable Slopes Report

An examination of WSDOT's collision database has revealed that for the period from January 1, 1970 through September 30, 2005 there have been no reported fatal motor vehicle collisions on Washington State Highways involving snow slides.

While there have fortunately been no reported traffic fatalities caused by snow slides on state highways, such incidents can result in injuries or property damage. In order to see any emerging trends in these types of collisions, a detailed analysis was done of all reported state highway collisions involving snow slides for the period from January 1, 1999 through September 30, 2005. This time frame was chosen because 1999 is the earliest year for which copies of collision reports are still available. By reviewing each collision report, it was determined if any other objects besides the snow, such as rocks or trees, contributed to the collision. If this were the case, such collisions were excluded from this analysis. As a result of this review, it was determined there was a total of 2 reported collisions involving snow slides during this time period, one of which resulted in property damage only (PDO).

Reported State Highway Collisions Involving Snow Slides

	1999	2000	2001	2002	2003	2004	Jan-Sep 2005	Total
PDO Collisions	1	0	0	0	0	0	0	1
Injury Collisions	0	0	0	1	0	0	0	1
Fatal Collisions	0	0	0	0	0	0	0	0
Total Collisions	1	0	0	1	0	0	0	2

Source: WSDOT, Transportation Data Office, Collision Data and Analysis Branch

In summary, reported collisions involving snow slides have been extremely rare occurrences during the last 6+ years. As a result, fortunately, there is insufficient data to ascertain any patterns other than the fact that the two collisions both took place on SR 2: at milepost 63.21 (2/22/2002, King County, approximately 1 mile west of Stevens Pass summit, Injury collision), and at milepost 92.15 (3/3/1999, Chelan County, approximately 7 miles west of Leavenworth, PDO collision).